Phys 2053: Homework V

due February 17, 2016

Schrödinger Equation

1._(3 p)_ Let us consider operators and eigenfunctions. Consider the functions

$$\begin{aligned} \phi_1(x) &= \cos kx \\ \phi_2(x) &= \sin kx \end{aligned} \tag{1}$$

and decide if those functions are eigenfunctions of the momentum operator. If they are not, then find a linear combination of the two functions, which is an eigenfunction of the momentum operator.

2. _(3 p)_ An electron moves in a one-dimensional lattice with the separation between adjacent atoms being equal to a,

(a) Write down the momentum eigenvalue equation for the electron.

(b) Find the general form of the solution of the eigenvalue equation.

(c) By requiring that the electron's wave function $\Psi(x)$ satisfies the periodic boundary condition

$$\Psi(a) = \Psi(0) \tag{2}$$

determine the possible values of the momentum of the electron.

2. _(4 p)_ An electron with a kinetic energy 4.0 eV is incident upon a potential barrier of height 5.0 eV and width 0.1 nm (similar to the barrier illustrated in Morrison Fig. 3.6). Estimate the probability that the electron will pass through the barrier.